

## **Implementation of RFID in Finland**

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<p><b>Abstract:</b></p> <p>This thesis focuses on the difference between Finnish companies and international companies regarding the implementation of RFID. To reach the goal of the thesis a survey was conducted, the survey was answered by big Finnish companies such as Kesko and Stockmann. The results are expected and in line with what the theory shows. Companies which have implemented RFID are happy with the technology; most of these companies also have plans to scale their programs. Companies which have implemented RFID see cost as a major issue for their programs. Those who have not implemented RFID mention cost as the main reason as to why they have not implemented RFID.</p> <p>To achieve full penetration of RFID in the Finnish marketplace a big player who could force other players to implement RFID would be needed, it does seem that there is no such player.</p>	
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# 1 INTRODUCTION

Radio Frequency Identification (RFID) is an identification technology which uses tags and readers, similar to the widely known barcode and reader combination. The main difference between these two technologies is that barcodes use a sensor and light whereas RFID uses radio waves. The use of radio waves also allows many products to be read at the same time when barcodes have to be read one at the time. RFID is mainly used in supply chains, but the fact that a tag can contain data means that the technology can be used in many different fields for example in marketing and logistics. This thesis will focus on the supply chain and warehouse management aspect of the technology.

RFID tags can then be seen as improved barcodes. Even though RFID can still be seen to be in its infancy, some companies have adopted RFID throughout their supply chains with success. Non-Governmental Organizations around the world (Rfid-lab in Finland) are lobbying for the use, and benefits, of RFID throughout the supply chain and at the point of sale. RFID is a technology that ‘has been coming’ for a long time, yet it is not yet widely implemented in Finnish companies. This thesis will investigate the main benefits and drawbacks of implemented RFID systems around the world and compare the results with the Finnish market. The reasons for why RFID has not been implemented are also studied. Even though a predecessor to RFID was first used in the Second World War to identify German planes the commercial use of this technology is still in its infancy. The main problem for many has been the price of implementing a RFID system; also, human beings tend to be quite opposed to big changes in the way of conducting things. In recent years it has been argued that the payoff of implementing RFID is almost immediate “*We conclude that when applied with recyclable transport containers, RFID investments can provide quick amortization of capital whilst offering a range of operational benefits.*” Kärkkäinen, 2003 Benefits of implementing RFID can be seen through; Reduced costs throughout the supply chain, better inventory accuracy and improved customer experience at the point of sales “*...will enable us to track individual products inside the store, thus helping us grasp the volume of customer interest—whether items are being carried to the fitting room or not, and whether they are taken to check out or returned to the shelves.*” (Swedberg, C. 2012).

## **1.1 Aim**

This research will investigate the implementation of RFID by Finnish companies. Benefits and challenges connected to the technology as well as attitudes towards the implementation of the technology will be studied. The research will also investigate if the perception of benefits from RFID differs between Finnish companies and foreign companies which have implemented RFID. The research focuses on Finnish companies within or with connections to the retailing industry. In the theoretical framework this research will also investigate RFID as a technology and the history of it to provide a background for the reader.

## **1.2 Significance**

Much research has been done on the benefits and disadvantages of RFID, the vast majority of these are concentrated on giants such as Walmart. As RFID is a scalable technology there is no 'one size fits all' solution regarding the implementation of the technology. The Finnish markets are vastly smaller than those on a global scale, this research concentrates on the Finnish retailing industry to see how it differs from those on a global scale.

## **1.3 Limitations**

This research will analyze the benefits of implementing a RFID system in a retailing environment through a survey, the results of the survey will be presented but no examples on "best practices" will be given. To give the reader an idea of what is discussed the research will also briefly study the technology itself. The research will focus on the Finnish retailing industry.

## **1.4 Research method and material**

This theory will be based on theories and cases regarding the implementation of RFID in the retail industry. This thesis also contains an empirical part, in which a survey which investigates the perceived benefits of RFID is conducted.

Sources used to conduct the literature reviewed range from journals regarding RFID and Supply Chains to studies and case reviews conducted by experts in the field of RFID. The method used in this study is called content analysis, this method allows for the capture and quantification of data from a wide range of sources. Sources used to find data about the subjects include; The Rfid Journal, RFID Lab Finland and different databases such as eBrary and Arken. Keywords used for gathering information are “RFID”, “RFID and retail”, “RFID and ROI” and “RFID and benefits”.

## **1.5 Definitions**

### **RFID**

Radio Frequency Identification is a technology used to track objects. An RFID system consists of an antenna and a transceiver, which transfers the information to a device which can interpret the signals received, and a RFID-tag containing the information about the product at hand.

### **LF**

Low Frequency

### **HF**

High Frequency

### **UHF**

Ultra High Frequency

### **CMOS**

Complementary Metal Oxide Semiconductor, a type of semiconductor which requires less power than ordinary chips due to the technology used.

### **EPC**

Electronic product code is a unique number stored in the RFID chip allowing the identification of a specific item in the supply chain.

### **NFC**

Near Field Communication is a short range RFID technology, often found in mobile phones. Needs to touch or be very close by to be able to read.



## **1.6 Structure**

This research is in four parts; an introduction, the theoretical framework, empirical research and discussion. The theoretical framework will consist of an overview of RFID as a technology, the potential benefits of implementing RFID-technology and a brief comparison of RFID and Bar codes.

To support the research questions, also negative aspects of implementing RFID will be studied. A survey researching the attitude of Finnish companies towards RFID is conducted to compare international companies to Finnish. The thesis will be concluded with a discussion regarding the material presented in the theoretical framework.

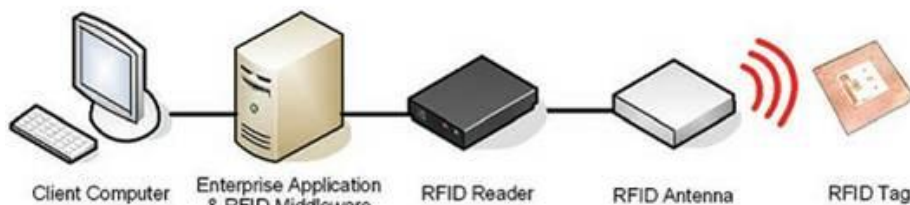
## 2 THEORETICAL FRAMEWORK

In the theoretical framework literature regarding RFID will be analyzed. This part will provide an overview and brief history of the development of RFID. Literature regarding the benefits of RFID in retailing, and the main concerns regarding RFID will be also be presented.

### 2.1 An overview of RFID-technology

Radio Frequency Identification allows for a tagged product to be uniquely identified. To work correctly three main components are needed to form a RFID-system;

1. Tag – The tag consists of a conductor chip and an antenna, the tag is connected to the product it represents and contains raw data regarding the product. A tag can be either active or passive; an active tag contains a battery to broadcast its signal while the passive tag draws power from the reader to broadcast its signal.
2. Reader – The reader communicates with the tag via Radio waves and transmits the data to the host.
3. Host – A host is most commonly a PC, containing appropriate software to translate the raw data from the tag to information which can be read by the end user.



*Figure 1 - The basic layout of an RFID-system(S. L. Ting, L. X. Wang, W. H. Ip, 2012)*

## **2.2 Radio frequencies**

### **Low Frequency**

The most commonly used frequency in this category is 125 kHz. Low frequency is most commonly used with passive tags since it has a very low reading distance. The low frequency allows for a great tolerance for interference in the signal transmitted. Low frequency is best used in identifying objects consisting of metal or other materials which could cause interference in the signal. LF is most commonly used in access control, animal identification and in car immobilizers.(Tielinen, 2011)

### **High Frequency**

High Frequency systems use the frequency of 13, 56 MHz to communicate. A higher frequency allows for communication between the tag and reader on a faster level and from a greater distance. The high frequency tag is also the cheapest to make since it is also used mainly in passive tags.

Drawbacks with HF-systems are that they are quite vulnerable to interference from outside factors for example different metals close to the tag. HF is most commonly used in smart cards and for example library control.(Tielinen, 2011)

### **Ultra High Frequency**

UHF uses different frequencies depending on location; in Europe the frequencies used are 433 or 865 MHz while In North America the frequency of 915 MHz is most commonly used. The high frequency allows the reading distance to be up to 10 meters. UHF is most commonly used in vehicle tracking and in supply chains to track pallets and containers.(Tielinen, 2011)

## **2.3 A brief history of RFID-technology**

The roots of RFID can be traced back to the Second World War, and the introduction of the radar. With the radar one could see airplanes moving, but could not know the intentions of the plane. Friendly airplanes were fitted with an antenna and transmitter which would respond to the signal sent by the radar. This technology was called the “IFF” – Identify Friend or Foe.(Tielinen, 2011)

The next development of RFID came in the 1980’s when farm animals needing special medication were tracked and identified using RFID-technology. Car manufacturers began embedding tags in their keys to the car which allowed for the car to recognize that the correct key was being used.(Tielinen, 2011)

### **2.3.1 The development of RFID-technology**

With the introduction of **CMOS** (Complementary Metal Oxide Semiconductor) passive RFID-tags could be developed further. During the 1980’s RFID established its place in the car industry and became more common in the manufacturing industry. The early Low Frequency tag needed a coil which was quite expensive to make, this hindered the development of RFID-technology. The development of RFID was quite limited during the 1980’s, mainly due to the high price and low reading distance provided by the LF-tags. (Tielinen, 2011)

The limitations of the LF-tag led to the development of the HF-tag. High Frequency tags eliminated the need for an expensive and rather large coil. The fact that coils were no longer required acting as an antenna allowed for the tags to become much smaller and flatter – much like the tags we see today. The increase in frequency also allowed for the tag to be read at a greater distance. After the development of the HF-tag the possibilities of implementation in global logistics and access control could be seen. The main constraint in the development was that no unified standard regarding RFID was done. In 1998 a project started at MIT, the purpose of the project was to develop a unified stand-

ard regarding RFID, from this project the **EPC** (Electronic Product Coding)-standard was born.(Tielinen, 2011)

EPC was originally supposed to be based on the HF-technology but the introduction of **UHF** (Ultra High Frequency) changed that. The many benefits of UHF compared to HF were for example the significant increase in the range and speed that the tag could be read. After the introduction of UHF the development of RFID started a rapid growth. UHF, with its many benefits compared to LF and HF was seen as a frequency which could most effectively be implemented into different industries. (Tielinen, 2011)

## **2.4 The benefits of RFID**

The benefits of RFID systems in this case are compared with the previous systems of the companies in question. The parcel tracking software is often the same or very similar to the ones in implemented in RFID systems, the main difference in the systems are that bar codes have been replaced with RFID tags – the benefit of RFID tags versus bar codes is the most important factor when discussing benefits of RFID. RFID has during the recent years become the pinnacle of technology regarding asset tracking, inventory management, supply chain management payment systems and information sharing. The retailing industry is one of the biggest industries in the world, and could be a major beneficiary from an effective implementation of RFID-technology. (Bhattacharya, Chu and Mullen, 2007).

The main benefits of RFID in retailing can be seen in the increase of operational efficiency (Bhattacharya, Chu and Mullen, 2007)., since RFID allows for many tags to be read simultaneously and tracked throughout the supply chain a dramatic improvement in stock accuracy and out of stock situations can be seen.

Improved visibility throughout the supply chain is a great benefit for a retailer; items and orders can be tracked in real time and shopping behavior can be analyzed by tracking items in-store. Other major benefits of a successfully implemented RFID-system are reduced labor costs, security against theft and improved information about packing and shipping. (Bhattacharya, Chu and Mullen, 2007).

The use of RFID in the retailing industry has its greatest benefits when it is implemented to support the operations at the point of sales. The implementation of RFID can have a big influence on the effectiveness of replenishment, warehouse management, distribution management and on sales and returns. At item level tagging it is possible to further study a specific consumer group and thus create consumer profiles on the data collected. On a long-term scale this could enable for retailers to provide for an individual shopping experience for every customer. (Roussos, London Uni.).

Item tracking can be further developed to the point of tracking for example the route inside the store, interaction with other products and for marketing purposes by suggesting additional products to go with the selected one.

A summary of the benefits of RFID tags compared to Bar Codes as provided by Jones, Wyld and Totten in *The Coastal Business Journal* Vol. 4, No. 1 p. 32.

<b>Bar Codes</b>	<b>RFID Tags</b>
• Bar Codes require line of sight to be read	• RFID tags can be read or updated without line of sight
• Bar Codes can only be read individually	• Multiple RFID tags can be read simultaneously
• Bar Codes cannot be read if they become dirty or damaged	• RFID tags are able to cope with harsh and dirty environments
• Bar Codes must be visible to be logged	• RFID tags are ultra thin, and they can be read even when concealed within an item
• Bar Codes can only identify the type of item	• RFID tags can identify a specific item
• Bar Code information cannot be updated	• Electronic information can be overwritten repeatedly on RFID tags
• Bar Codes must be manually tracked for item identification, making human error an issue	• RFID tags can be automatically tracked, eliminating human error

Figure 2 - RFID vs. Bar Codes (Jones, Wyld and Totten, 2005)

In the comparison between the two technologies one can clearly see the abundant benefits of RFID tags versus bar codes; RFID tags can almost always be read much faster and easier than bar codes.

## 2.5 Successful implementation of RFID-technology

The success of implementing a new technology is most often measured by the **ROI** (Return on investment). The implementation of RFID often has a dramatic increase on the effectiveness of operations, thus increasing productivity. A good example on the increase in productivity can be seen in the case of Wal-Mart; Wal-Mart was able to reduce the pallet build rate from 90 seconds to 11 seconds by using RFID, which is a reduction of almost 90% (Pisello, T. 2006).

Some companies still decide to implement RFID regardless of the ROI because of its numerous other benefits, mainly the increased visibility in the supply chain and the increase of effective operations (Collins, 2004).

### 2.5.1 Wal-Mart

Wal-Mart is the biggest retailer in the world with total revenue of 447 billion dollars in the year of 2011. The company has always been quite advanced in the use of technology to support its operations, in 1983 Wal-Mart set up its own satellite communication system to effectively track inventories around the United States. In 2003 Wal-Mart asked its top 100 suppliers to tag their products with RFID tags by January 2005, Wal-Mart wanted to replace the bar code technology with RFID because they believed it would reduce costs in the supply chain and improve the overall efficiency. (Axline, 2005)

According to the article by Leslie Hand in Global Retail Insights the concrete benefits of the implementation of RFID to Wal-Mart included among others a big **Reduction in inventory counting labor**. Due to the fact that line of sight to scan products coming to a warehouse was no longer needed Wal-Mart experienced a decrease of 25 percent in inventory counting labor. With a higher number of items passing through the effectiveness of operations would also increase since the scanning of a pallet of products always takes roughly the same time. Another benefit that was found was the **Reduction in inventory**, the increased visibility of inventories at the point of sales allowed for the retailers to keep the stock at an optimal level at all times. (Hand, 2010)

**Out of stock-situations** in Wal-Mart stores were reduced by 16 percent in the first twelve months of implementation. Products which were fitted with RFID tags could be

replenished three times as fast as the products without a tag. (Axline, 2005) Walmart also experienced an **Increase in sales** which was estimated to be around 4-15 percent. Along with the increase in sales **Reduced shrinkage** was seen as a great benefit at the different points of sale. Shrinkage due to theft could be reduced by up to 50 percent because retailers were able to track products in-store in real time. (Hand, 2010)

### 2.5.2 Billabong

The apparel retailer Billabong decided to implement a RFID-system at one store in Brazil. The system allowed customers to select pieces of apparel in the changing rooms. Other aims of the system were also to provide a deeper insight into the inventory and security data for the staff. During the first week of implementation the store experienced an increase of over 300 customers in the store. The pilot was deemed to be quite successful since the store was able to reach a new customer segment. The new customer was described by the President of Billabong, Regiane Relva Romano as someone who:

"values innovation and understands that technology can provide a differentiated shopping experience." (Swedberg, 2011)

In late 2012, much due to the success in Brazil, Billabong decided to roll out with a similar RFID system in over 100 stores in the United States. One of the reasons to go ahead with such a big venture was to differentiate their stores from the competition. (Morerfid, 2013)

### 2.5.3 Conclusions

A successfully implemented RFID-system can have a positive impact on many different areas, throughout the supply chain. The main benefits can be perceived in the transparency of the supply chain and the increase in effectiveness – both factors contributing to the success of operations.

Another factor which can improve the in-store operations are the different applications which are consumer focused. The consumer focused applications include smart shelves, which can for example start playing the trailer of a DVD removed from a stand. Smart



dressing rooms can recognize the apparel brought to the dressing room and can make suggestions on alternative or matching products.

## 2.6 Concerns regarding RFID

Regardless of the many benefits of implementing a system based on RFID-technology there are some concerns over the technology. The main concerns are cost, lack of standards, privacy and fear that large retailers will have an increased position of power due to the technology.

The following figure presented by Bhattacharya, Chu and Mullen (2007) presents the main challenges regarding RFID systems in a visual manner. According to the research Privacy issues are the main concern, followed by standardization and cost.

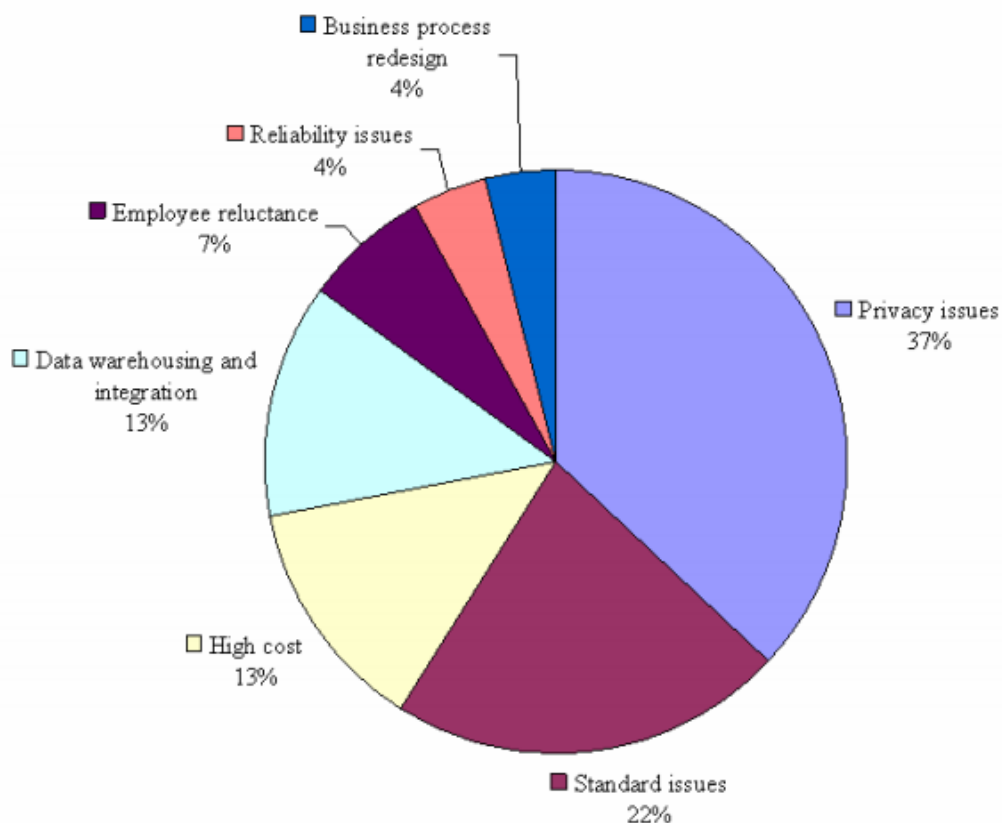


Figure 3- The challenges with RFID (Bhattacharya, Chu and Mullen (2007))

### **2.6.1 Privacy**

When RFID was mainly used only in Logistics management the security risk did not seem very relevant to consumers, as more and more RFID applications have been directed towards consumers the possible lack of privacy has become an issue for the everyday consumer. Some see RFID as a technology which could lead to an Orwellian society with cradle-to-the-grave surveillance.

According to Melanie R. Rieback, Bruno Crispo, and Andrew S. Tanenbaum in the article *The Evolution of RFID Security* in the *Rfid Guardian*, 2006, security threats can be divided into five categories;

#### **Sniffing**

As the tags do not have the ability to “think” or process data by themselves they can be read by basically any reader, even from a great distance. Another form of sniffing is to eavesdrop on the traffic between a tag and reader. When the access to data on a tag is seemingly unrestricted, serious implications could be seen in the form of for example medical records or unusual personal inclinations. The utilization of this information could easily be used against a person. (Rieback M. Crispo, B. Tanenbaum, A., 2006)

#### **Spoofing**

Spoofing is when the attacker re-programs the data on a chip to represent the data of for example a similar cheaper product. Cloning a tag is another form of spoofing which creates a copy of an existing tag; the copy can then be used just as the original tag. (Finkenzeller, 2009)

#### **Tracking**

RFID-technology does pose the possibility of tracking an individual. RFID-tracking is at the moment in use in warehouses and used to track the time it takes an employee to perform a certain task. The workers union in the United Kingdom, GMB, called for a ban on employee tracking in 2005, saying it dehumanizes staff. In 2007 a ban for tagging employees was issued in California. (Eyre, 2007)

## **Relay Attacks**

As the name suggests, relay attacks are a form of eavesdropping where the signal from a tag is interrupted and sent forwards to the reader – or vice versa. The third party records the signal from either tag or reader to be used when wanted. Rieback, Crispo and Tanenbaum offer the example of avoiding congestion charges in London by stealing the signal from a car entering London. Relay Attacking does allow for more serious crimes than the avoidance of congestion charges. One form is virtual pick-pocketing, Virtual pick-pocketing occurs when a credit card is read by an unauthorized reader (Leach), the data is sent to a fake tag (Ghost) which can now be used as the credit card or access key. As many phones possess NFC (Near Field Communication) a form of Radio Frequency Identification, a phone can be used as both Leach and Ghost. The communication between Leach and Ghost is fast and effortless through the Internet. (Finkenzeller, 2009)

## **Denial of service**

Denial of service takes a more hands on approach. This technique consists of simple tricks such as removing an RFID-tag or placing a product in a bag lined with aluminum foil which prevents the signal from the tag to reach the reader. (Finkenzeller, 2009)

### **2.6.2 Solutions for privacy issues**

The holes in the security of RFID are quite apparent, that is why different countermeasures have been taken to prevent the theft of information. These measures include among others; tag killing, encryption, passwords and blocker tags. Encryption is quite straight forward, it allows for a tag to be read only by one single reader or an array of readers. The main problem with encryption is that it would drive the cost of a single tag-reader-combination up. Personal passwords take the encryption to the user; a password would be required to allow the tag to send out personal information. Password protection does on the other hand bring out the possibility of actually making life more difficult for the consumer, since the consumer would have to manage and remember passwords for all the different tags. (Finkenzeller, 2009)

Rather than using passwords the tag itself could be programmed to change its identity each time it is used. This would make the tracking of one single tag quite difficult since there would be no way of knowing all the pseudonyms for a single tag. The pseudonyms could also be renewed by a reader with a certain interval. A blocker tag takes a more aggressive approach to RFID security. The blocker tag would be attached near the original tag and transmit a signal which would make readers unable to read any tags. The signal could however be programmed in such a manner that a designated reader could read the information from the original tag. Blocker tags could also see utilization in logistics; a blocker tag could be attached to a shipment during transportation and removed at its final location to prevent unauthorized reading of the tags. (Garfinkel, Juels and Pappu, 2005)

### **2.6.3 Lack of standards**

The lack of standards or the existence of many different standards regarding RFID has been impeding the development of this technology. Two major players can be identified, ISO (International Standards Organization) and EPC Global. These two entities have had different views on the standardization of RFID. The standards developed have often been incompatible with each other – leading to closed systems. Even though there is a clash between two parties some standards regarding the use of RFID have been made. ISO has come up with a variety of different standards regarding RFID, these standards include for example; the tagging of animals, identification cards item management and different applications in information technology. (Bhattacharya, Chu and Mullen , 2007)

### **2.6.4 Cost**

The cost of implementing an RFID-system cannot be specified since the solution will most likely differ from company to company. When implementing a system the costs generated are not just from tags and readers. A company needs to invest in software that is able to handle the information from the tags and most likely also make changes to standard operating procedures affected by the implementation of RFID. (Violino, 2005)

As the first companies began to implement RFID the technology was still in quite an early stage, this meant that the implementation process was more expensive than today. In 2004 companies spent millions of dollars implementing RFID – since that, prices for all components in a system have come down. (Maurno, 2005) The cost of implementation also depends on the level of implementation and the size of the company implementing RFID. According to an example in an article by Bob Violino in the RFID Journal the total costs of implementing an RFID-system for a 12 billion dollar manufacturer around 600 000 dollars to fully implement RFID technology.

### **3 METHOD**

The empirical part of this thesis was done by conducting a survey. The reason a quantitative survey was chosen as the method was because the questions that needed to be answered were specific. The benefits of a quantitative research are that the data obtained is based on real world observations. Since the survey usually covers a broad part of a population means that it can easily be generalized. (Kelley, Clark, Brown and Sitzia, 2003) Another benefit of surveys is that the data is easy to analyze and present in an easy to read format.

#### **3.1 Implementation of the Survey**

The questions in the survey were chosen thanks to the broad scale of answers to questions given. Some of the questions were found in a survey conducted by Accenture regarding item level RFID tagging. The purpose of the survey is to first give a general view over the implementation of RFID in Finland after which more specific questions were asked, an example of the survey can be found in the attachments.

All in all 21 companies answered the survey. The majority (16) of the answers to the survey were gathered during an event organized by RfidLab Finland in October of 2013, companies of all fields of industry were represented, nobody refused to answer the survey. A mass email was sent out in January 2014 to which 5 companies answered. The mass was sent to a large number of people representing companies in the retail industry in Finland, an attachment of the email can be found in the attachments of this thesis. The email had a low answering percentage.

Companies at the seminar, for example Stockmann and R-Kioski were chosen because of their “big player”-status in the Finnish marketplace. Other companies, big or small were chosen because of their interest in RFID as a technology. To complete the survey and bring more credibility to it companies which did not attend the seminar were contacted through email. These companies included big players such as Kesko, Lähikauppa and Tokmanni.

The survey is built to answer general info first after which more specific questions are answered. Companies which had not implemented RFID in their business yet were

asked to answer only questions 1-4. Companies which had implemented RFID were asked to answer questions 1 and 2 and 5-8.

The survey conducted for this thesis did not include very specific questions about the companies which answered it. The survey was conducted by contacting representatives for Finnish companies in the retailing business. Companies which answered the survey include; Kesko, R-Kioski, Stockmann and Valio. As the before mentioned companies are big players in the Finnish retailing and distribution business the data received from the survey gives a good wireframe of the industry as a whole. The questions in the survey were constructed to be as quantifiable as possible with the answers directly contributing to the aim of the thesis.

The survey tool used for the research is called Webropol. The tool provided an opportunity to analyze the results with ease.

## 4 RESULTS

In this part of the thesis the results of the survey will be presented and analyzed. Each question of the survey will be presented along with a short commentary on the question.

### 4.1 Turnover

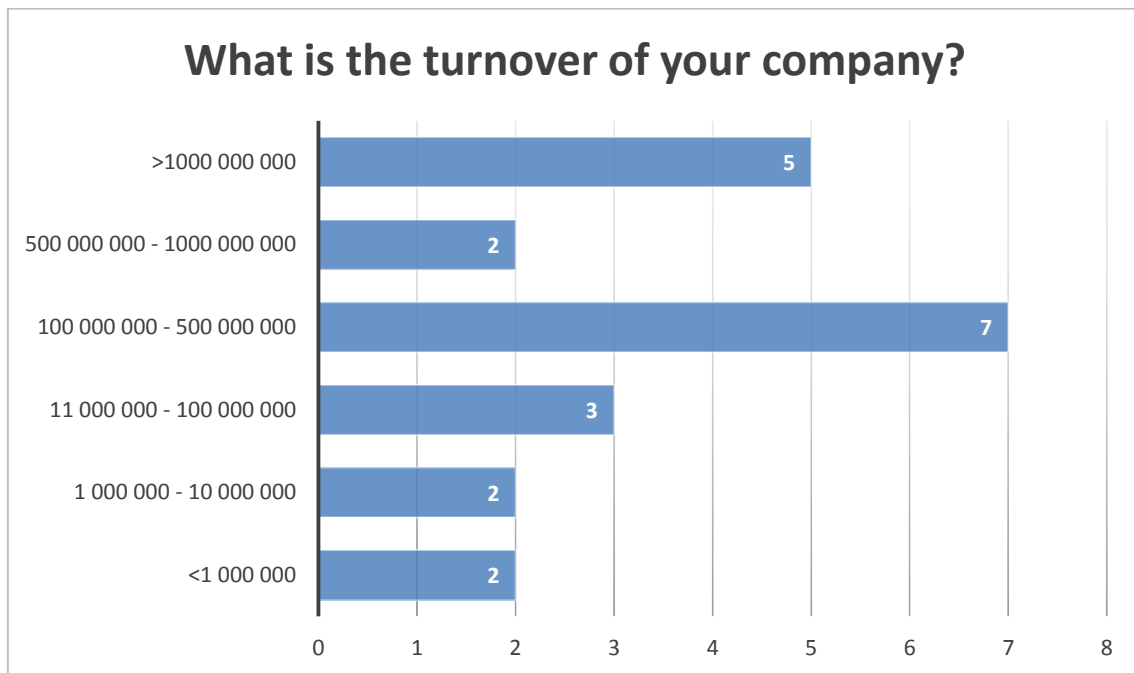
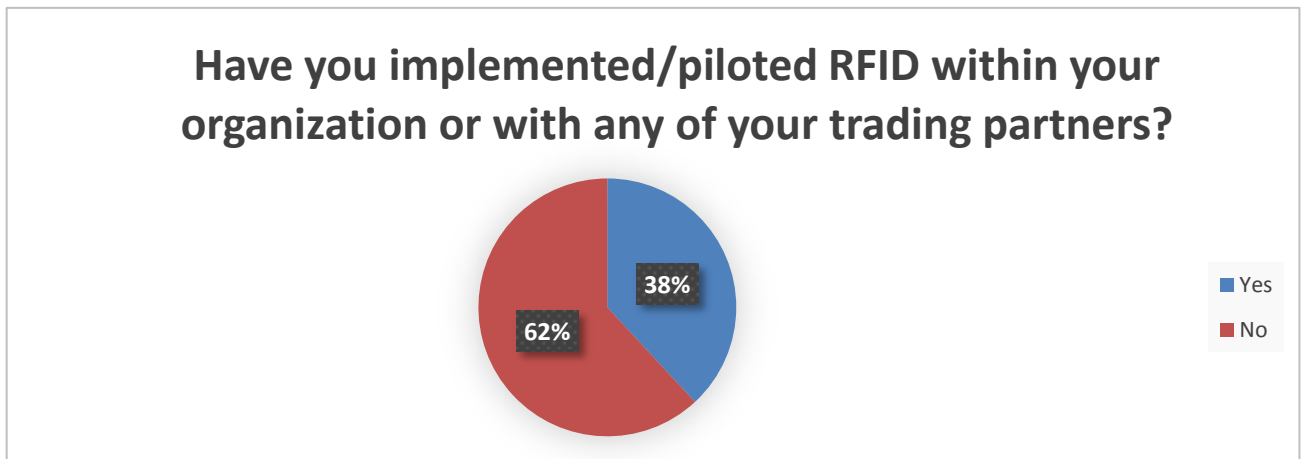


Figure 4- Turnover of companies

The above graph indicates the turnover of the company answering the survey. The majority of companies have a large turnover (over 100 000 000 €) which is well representative of the retailing industry.



## 4.2 Have you implemented RFID?



*Figure 5- Have you implemented/piloted RFID within your organization or with any of your trading partners?*

This question is absolutely integral to the thesis, it gives an overview of whether companies have or have not implemented RFID. The majority, 62%, of companies have not implemented RFID at any point of their supply chain.

### 4.3 Plans for RFID

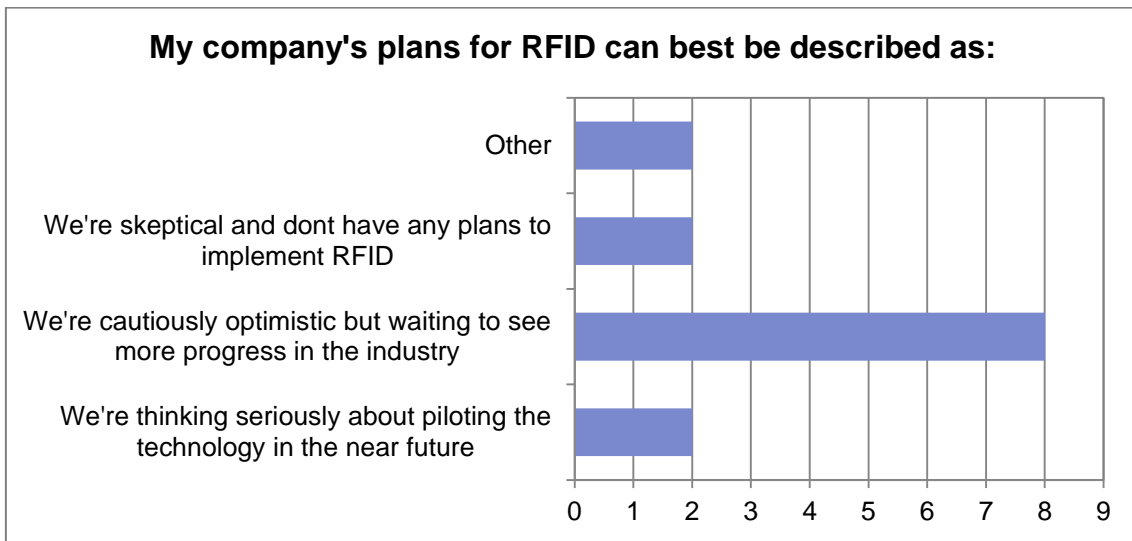
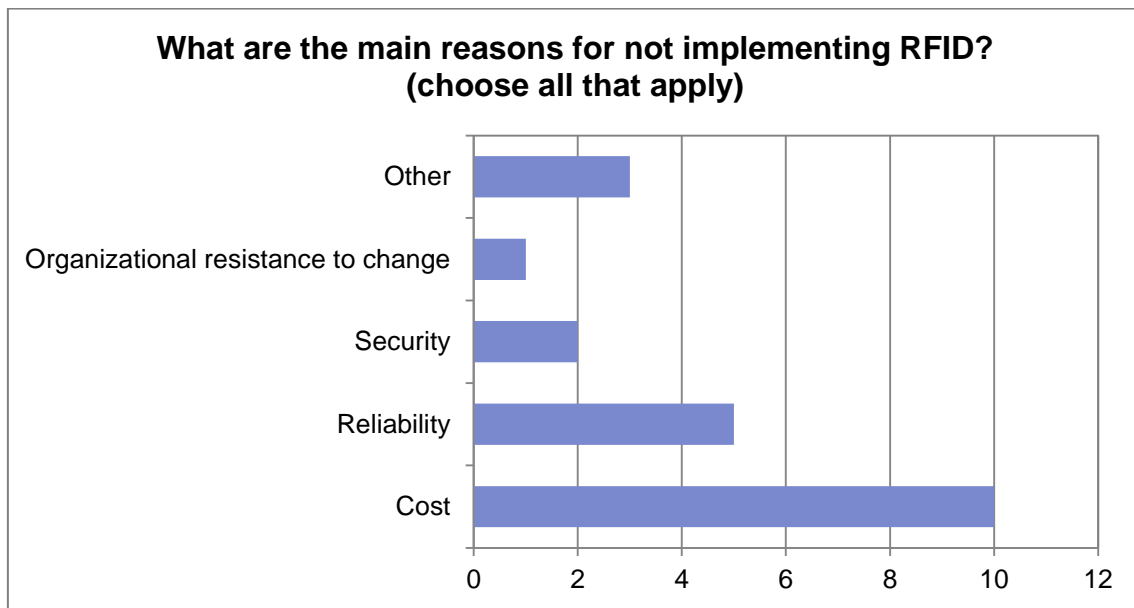


Figure 6 - Plans for RFID

The purpose of this question was to gather information about the attitudes and thoughts of RFID as a viable technology at this moment. This question reflects the industry view on RFID at the moment. The answer “We’re cautiously optimistic but waiting to see more progress in the industry” was the answer of a vast majority of the surveyed. It seems that companies do not want to be the spearhead in implementing this technology. Two companies answered that they are skeptical and have no plans to implement RFID in the future, this could be due to a small turnover (see chart 1) and the thought that the benefits are not good enough to implement RFID on such a small scale.

#### 4.4 Main reasons for not implementing RFID

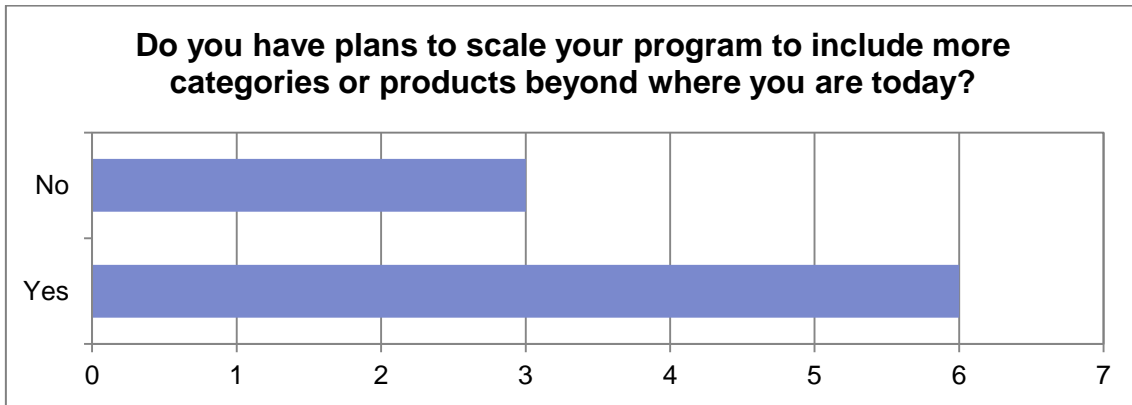


*Figure 7- Main reasons for not implementing RFID*

The main reason for not implementing RFID is cost, which is understandable in the current economic climate where companies are trying to cut costs on all fronts. To invest in a technology which is not seen as fully mature (Reliability) yet is something companies are not ready to do yet.

Security and Organizational resistance to change seem to be of less importance to the companies operating in Finland.

## 4.5 Plans to scale?



*Figure 8 - Plans to scale RFID program*

This question was answered only by those who already have implemented RFID. Six out of nine already have plans to further scale the already implemented RFID program in their company. The answers to this question indicate that those who have implemented RFID have found that the technology has a positive impact on the company and its operations.

#### 4.6 What are the perceived benefits of your RFID program?

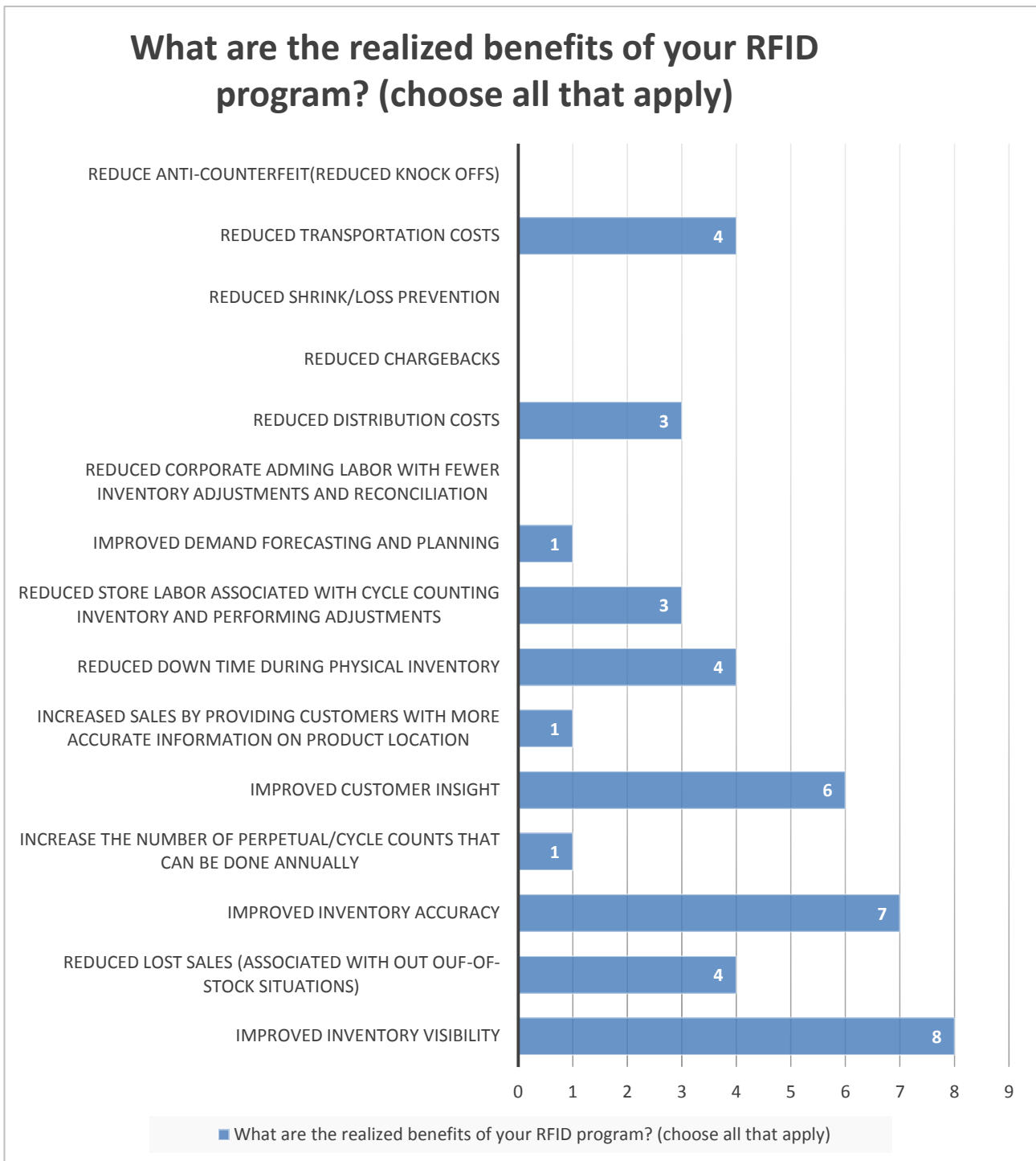


Figure 9 - Perceived benefits of the RFID program

The largest perceived benefits of a successfully implemented RFID program relate to inventory and inventory visibility. 8 out of 9 have experienced an improved visibility in their inventory while 7 out of 9 have experienced a more accurate inventory. Other benefits relating to inventory management are that 4 out of 9 have experienced a reduction in sales due to out of stock situations. Down time during physical inventory is also a big factor with 4 out of 9 perceiving this as a benefit.

As RFID allows for more effective distribution of a product 4 out of 9 have reduced their transportation costs after implementing RFID, while 3 out of 9 have reduced transportation costs.

6 out of 9 companies have perceived an improved customer insight.

## 4.7 Greatest challenges regarding RFID

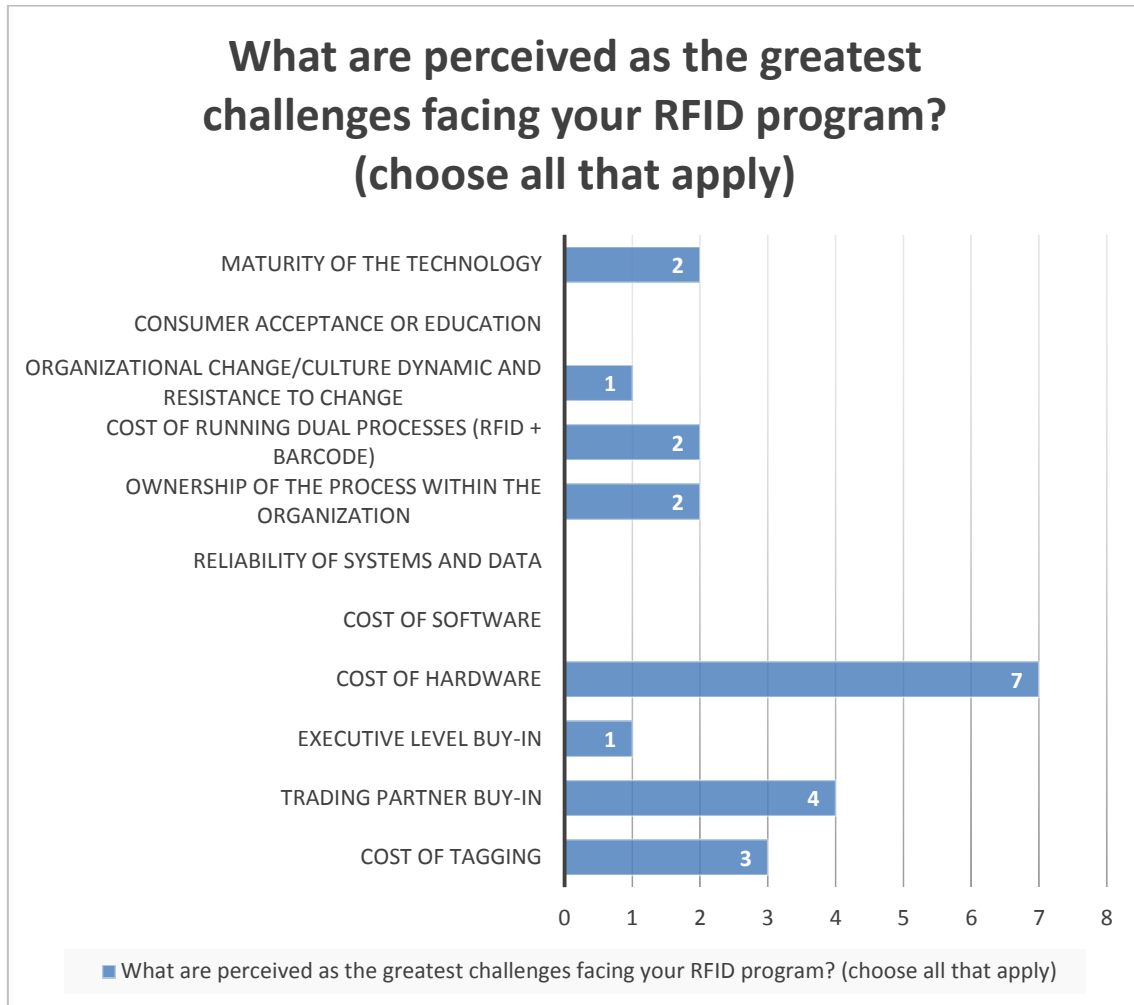


Figure 10 - Greatest challenges regarding RFID program

The last quantitative question asked about the perceived challenges of implementing RFID.

As in the reasons why not to implement RFID price was once again the biggest challenge companies are facing. 7 out of 9 perceive the cost of hardware as a challenge while 3 out of 9 perceive the cost of tagging as a challenge.

2 out of 9 perceived the cost of running dual processes (barcode and RFID) as a challenge. This relates to the second biggest perceived challenge.

The second biggest perceived challenge is the trading level buy-in, the implementation

of RFID could be useless if the partners have not or will not implement RFID.

In the Finnish markets there are no such big players that could influence or force suppliers/retailers to implement RFID, as in the case of Walmart.

Maturity of the technology, ownership of the process within the organization, executive buy-in and resistance to change are not perceived as big challenges in most of the companies and can thus not be generalized.

#### **4.8 Question 8 – Respondents own thoughts**

The last question allowed the respondents to write own thoughts regarding the use of RFID in Finland. The answers are below;

- 1. There are many possibilities so I would say that the future is bright for RFID. Now the technology seems to be on a mature level and the unit cost is decreasing.*
- 2. Positive!*
- 3. Uncertain*
- 4. Due to small company sizes, implementing a costly technology is not cost effective.*
- 5. We need to wait for the technology to be more mature*

These answers are in line with the rest of the answers in the survey. Cost is brought up as a concern once again.

The answers indicate that the view on RFID as a technology is largely positive, but companies still want to wait for the technology to reach a more mature level and the cost of implementing the technology on a wide scale to go down.



## 4.9 Conclusion

The results of this survey were expected and positive. The attitudes of Finnish companies are well summed up in question 8 in which the respondents were allowed to share thoughts of their own. The attitude seems to be largely positive with a small injection of uncertainty.

Cost seems to be the major issue for the companies which have implemented RFID and the companies which have not.

The plans for the future implementation can almost be described as typically Finnish, “wait and see what the other guys do”.

Although the attitude towards RFID seems to be a tad cagey, those who have implemented the technology seem to be very happy with the decision to do so. The companies which have implemented have seen improvements all along the supply chain, from warehouse to point of sale.

A small majority of companies already have plans to scale their RFID program.

## 5 DISCUSSION

In the next part the theory and results of the survey in relation to the theory will be discussed. As discussed in the first part of the theoretical framework, RFID as a technology is not a new one – what is new is the commercial application of RFID. The tag and reader-combination has not seen significant changes since the 1980's. RFID was mainly used in the manufacturing industry but further application of the technology was researched. In the late 1990's a boost in the development of RFID can be seen with the EPC-standard leading the way. Another significant step was the introduction of the Ultra High Frequency which allowed for easier application into a specific industry.

Retailing is an industry which can benefit from RFID on all levels of operation – from manufactory to the point of sales. One can choose to implement applications on all levels of operation or just on a specific level; benefits can be drawn at each level separately. The flexibility of this technology can be seen in examples in the theoretical framework, Wal-Mart and Billabong. Wal-Mart can be seen as a pioneer of RFID in retailing, they were the first big company to start the implementation of RFID. Wal-Mart decided to implement RFID on all levels of operation, and extend the implementation to their entire supply chain by imposing a rule to all their suppliers stating that all items should be tagged with RFID tags using EPC. Wal-Mart can thus also be seen as a company lobbying for a unified standard of product coding in the entire retailing sector.

In the case of Wal-Mart the company's goal was to reduce overall costs in the supply chain and improve efficiency. By looking at the numbers given by Leslie Hand one can state that big improvements were seen. The percentages do vary quite a lot, but when thinking of the scale a company like Wal-Mart is operating one can conclude that significant improvements in both operational efficiency and cost reductions were seen.

When looking at the results of the survey one can see that the data collected from the Finnish market supports the theories provided in the theoretical framework. The companies that have implemented RFID have seen it largely as a positive.

8 out of 9 companies have seen an improvement in inventory visibility, while 7 out of 9 have experienced and improved accuracy in inventory. Finnish companies have not, and cannot implement RFID on such a scale as Walmart did – the investment might backfire

in a glorious fashion due to the cost and the reluctance towards change of Finnish companies.

On the other end of the scale from full implementation is the implementation of RFID at only one stage of the supply chain. Modern and innovative applications of RFID in the point of sales are tailored towards the consumer, for whom the shopping experience has to be as enjoyable as possible. The benefits Finnish companies have seen on the store level range from reduced store labor and reduced time doing physical inventory to improved customer insight. The idea of a “smart store” has not yet reached Finland on a broad scale. Some applications can be seen but they are more of a novelty than something that provides customers with actual help.

RFID makes the modernization of a store possible by providing solutions for both consumer engagement and convenience. Convenience is provided for example by offering a chance for payment by NFC based mobile wallets and smartcard based payments. (Morerfid, 2013) As one can see by purely observing his surroundings it is evident that more stores have decided to modernize at least their front end customer experience by providing wireless payment.

From the examples above one could conclude the extent of implementation depends entirely upon the goals and intentions of the company implementing RFID. Naturally bigger companies, such as Wal-Mart can draw more benefit from the implementation of RFID into the entire supply chain than a smaller company. The benefit of RFID can thus be seen as exponential, the more traffic goes through a location the more benefit can be drawn from RFID, since the time to read any given amount of items takes the same time as reading one.

Even though there are a lot of positive aspects about RFID as a technology one must not forget the negative aspects when contemplating whether or not to implement RFID at a given stage of the supply chain. Cost is to be seen as the main issue affecting the decision to implement RFID or not. Even though the costs have come down in recent years, the implementation is still a much larger venture than acquiring tags and readers. The process requires meticulous planning and testing, someone is most often needed to be hired to install the software and school staff to use the new technology. To achieve the

goals set from the implementation, mere implementation is not enough but vast changes to standard operating procedures often have to be made.

The survey provided insight into the challenges companies in Finland face – cost naturally being the highest thing to worry about. Interestingly also the reliability of the technology was put into question, this might be due to own experiences or the lack of information regarding the technology.

Almost half of Finnish companies which have implemented RFID have faced challenges on partner level buy-in. A company cannot draw full benefit of a technology such as RFID if it can't be used how it is supposed to be used – throughout the supply chain. Touching this issue is the fact that 2/9 companies see running both RFID and barcodes as a major issue.

At 68 %, the majority of Finnish companies have still not implemented RFID. The main issue for companies is the cost of implementing this technology. This differs from the survey done by Bhattacharya, Chu and Mullen in 2007 where the main issue for not implementing RFID was the perceived security threats at 37 %. In the survey conducted by Bhattacharya, Chu and Mullen cost was perceived as the third biggest concern regarding the technology with only 13% of the respondents seeing it as an issue.

This tells that the technology itself has taken big steps towards maturity during the last six to seven years.

Although Finnish companies do not see privacy as a very big risk it is an issue which is to be taken quite seriously. Issues regarding privacy in RFID are being solved, and different methods have been introduced. All methods do naturally have some drawbacks and no perfect solution is yet to be found. A big part of the negative buzz around security regarding RFID is generated by the website [www.spsychips.com](http://www.spsychips.com); the articles on the website do have a negative tone. One could say that the articles are designed to stir up a negative image of RFID by painting the technology in a certain way. The lack or division of standards is a factor which may have a greater impact on the retailing business. This was seen by Wal-Mart quite early on as they imposed the rule which made suppliers conform to their standards. The fact that big retailers can impose rules and dictate operating procedures, which may be unbeneficial to smaller suppliers, can be seen as

both negative and positive. The negative aspect of this is that there is one or two huge retailers who are able to control their suppliers while the positive aspect is that this method does more or less mean that one standard can be used in the entire industry. The Finnish retailing industry could largely benefit of such a bully - or trendsetter if you will.

### 5.1.1 Conclusions

The aim of this thesis was to (1) investigate how the perception of benefits from RFID differs between Finnish companies', which have implemented RFID and foreign companies which have implemented RFID. (2) Give an overview of RFID as a technology.. There is no specific mold which can be used by a company wishing to implement RFID; all solutions have to be tailor made to suit a specific situation. The positive aspects are proven, and RFID does improve the efficiency of operations significantly compared to existing standards, the existing standard being bar codes. The Finnish attitudes and perceptions towards RFID in Finland are largely the same as the ones of the so called big players in the industry. Since the commercial use of RFID is a fairly new idea there are still a few concerns regarding this technology, which might turn potential users away. The two main concerns are the price of implementation and the perceived security threats. These concerns are recognized by the people who are developing RFID for commercial use and these kinks will most likely be sorted out in the near future. As the use of RFID is quite new in the Retailing business one cannot expect every company in the world to implement it instantly. The number of companies using RFID on any scale is increasing yearly, if not weekly, with the further development of RFID the implementation will be significantly wider in a few years' time.

#### **Further studies**

To keep this thesis in line with the aim and limitations set many interesting applications for RFID were not investigated, Subjects not investigated in this thesis but which are worth to study further include for example **NFC-Payments, In-Store Applications** aimed to help/further market products to a customer or the **automation of processes** at the end customer level.

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### **Terminology:**

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## ATTACHMENTS

### Kysely opinnäytetyötä varten



**Otto Kullberg** <otto.kullberg@gmail.com>

Feb 28 



to petteri.niemi 

Hei,

Työstän tällä hetkellä opinnäytetyötä Ammattikorkeakoulu Arcadassa. Työn aiheena on RFID:n käyttö kaupan alalla suomessa. Olisin erittäin kiitollinen mikäli osallistuisit laatimaani kyselyyn. Kyselyyn vastaamiseen mene muutama minuutti.

Mikäli tahdot että lähetän työn sinulle sen valmistuttua, ole ystävällinen ja kirjoita sähköpostiosoitteesti tekstiruutuun kyselyn lopussa.

Kyselyyn pääset tämän linkin kautta:

[Webropol](#)

Ystävällisin terveisin

Otto Kullberg

*Attachment 1*

## RFID in retailing

**1. What is the turnover of your company? \***

- <1 000 000
- 1 000 000 - 10 000 000
- 11 000 000 - 100 000 000
- 100 000 000 - 500 000 000
- 500 000 000 - 1000 000 000
- >1000 000 000

**2. Have you implemented/piloted RFID within your organization or with any of your trading partners? \***

- Yes
- No

If you answered no to question 2, please answer only questions 3 and 4. If you answered yes, please continue to question 5.

**3. My company's plans for RFID can best be described as:**

- We're thinking seriously about piloting the technology in the near future
- We're cautiously optimistic but waiting to see more progress in the industry
- We're skeptical and don't have any plans to implement RFID
- Other

**4. What are the main reasons for not implementing RFID? (choose all that apply)**

- Cost
- Reliability
- Security
- Organizational resistance to change
- Other

**5. Do you have plans to scale your program to include more categories or products beyond where you are today?**

- Yes
- No

**6. What are the realized benefits of your RFID program? (choose all that apply)**

- Improved inventory visibility
- Reduced lost sales (associated with out of-stock situations)
- Improved inventory accuracy
- Increase the number of perpetual/cycle counts that can be done annually
- Improved customer insight
- Increased sales by providing customers with more accurate information on product location
- Reduced down time during physical inventory
- Reduced store labor associated with cycle counting inventory and performing adjustments
- Improved demand forecasting and planning
- Reduced corporate admin labor with fewer inventory adjustments and reconciliation
- Reduced distribution costs
- Reduced chargebacks
- Reduced shrink/loss prevention
- Reduced transportation costs
- Reduce anti-counterfeit(reduced knock offs)

**7. What are perceived as the greatest challenges facing your RFID program? (choose all that apply)**

- Cost of tagging
- Trading partner buy-in
- Executive level buy-in
- Cost of hardware
- Cost of software
- Reliability of systems and data
- Ownership of the process within the organization
- Cost of running dual processes (RFID + Barcode)
- Organizational change/culture dynamic and resistance to change
- Consumer acceptance or education
- Maturity of the technology

**8. How do you see the future of RFID in Finland? (optional)**

Skicka